

Assignment – 4

Topic: Internal Combustion Engine.

(Disclaimer: The purpose of these AI-generated responses is just education and reference. Utilise them to grasp topics and structure, but always rewrite in your own words and double-check the content before submitting.)

Q-1: A four stroke petrol engine has a stroke volume of 6 litres. Its mean effective pressure is 550 kN/m² and r.p.m. is 750. Find the indicated power of the engine.

Answer:

Given:

- Swept Volume, $V_s = 6 \text{ litres} = 0.006 \text{ m}^3$
- Mean Effective Pressure, $mep = 550 \text{ kN/m}^2 = 550 \text{ kPa}$
- Speed, $N = 750 \text{ rpm}$
- Type: Four-stroke engine

Step 1: Apply Indicated Power Formula for Four-Stroke Engine

For a four-stroke engine, the number of power cycles per minute is $N/2$.

The formula for Indicated Power (IP) is:

$$IP = \frac{mep \cdot V_s \cdot (N/2)}{60}$$

$$IP = \frac{550 \times 0.006 \times (750/2)}{60}$$

$$IP = \frac{550 \times 0.006 \times 375}{60}$$

$$IP = \frac{1237.5}{60} = 20.625 \text{ kW}$$

∴ Indicated Power = 20.625 kW

Final Answer for Q-1:

Indicated Power = 20.63 kW

Q-2: A two cylinder four stroke engine has a bore of 120 mm and stroke is 1.25 times the bore. The engine runs at 1000 r.p.m. If the mean effective pressure is 600 kN/m². Find the indicated power of the engine.

Answer:

Given:

- Number of cylinders, $n = 2$
- Bore, $D = 120 \text{ mm} = 0.12 \text{ m}$
- Stroke, $L = 1.25 \times D = 1.25 \times 0.12 = 0.15 \text{ m}$
- Speed, $N = 1000 \text{ rpm}$
- $mep = 600 \text{ kN/m}^2 = 600 \text{ kPa}$
- Type: Four-stroke

Step 1: Find Swept Volume per cylinder (V_s)

$$V_s = \frac{\pi}{4} D^2 L$$

$$V_s = \frac{\pi}{4} (0.12)^2 (0.15)$$

$$V_s = 0.7854 \times 0.0144 \times 0.15 = 0.001696 \text{ m}^3$$

Step 2: Find Total Indicated Power (IP)

For a four-stroke, multi-cylinder engine:

$$IP = \frac{mep \cdot (V_s)_{total} \cdot (N/2)}{60}$$

Where $(V_s)_{total} = n \cdot V_s = 2 \times 0.001696 = 0.003392 \text{ m}^3$

$$IP = \frac{600 \times 0.003392 \times (1000/2)}{60}$$

$$IP = \frac{600 \times 0.003392 \times 500}{60}$$

$$IP = \frac{1017.6}{60} = 16.96 \text{ kW}$$

∴ Indicated Power = 16.96 kW

Final Answer for Q-2:

Indicated Power = 16.96 kW

Q-3: A 6 cylinder 4 stroke I.C. engine is develop 89.5 KW ip at 800 r.p.m. The stroke to bore ratio is 1.25:1 Assuming mechanical efficiency of 80% and brake mean effective pressure of 5 bar, determine the diameter and stroke of engine.

Answer:

Given:

- Number of cylinders, $n = 6$
- Indicated Power, $IP = 89.5 \text{ kW}$
- Speed, $N = 800 \text{ rpm}$
- $L/D = 1.25$
- Mechanical Efficiency, $\eta_m = 80\% = 0.80$
- Brake Mean Effective Pressure, $b MEP = 5 \text{ bar} = 500 \text{ kPa}$

Step 1: Find Brake Power (BP) and Total Swept Volume

$$\eta_m = \frac{BP}{IP}$$

$$BP = \eta_m \times IP = 0.80 \times 89.5 = 71.6 \text{ kW}$$

For a four-stroke engine:

$$BP = \frac{b MEP \cdot (V_s)_{total} \cdot (N/2)}{60}$$

Rearrange to find total swept volume:

$$(V_s)_{total} = \frac{BP \times 60}{b MEP \times (N/2)}$$

$$(V_s)_{total} = \frac{71.6 \times 60}{500 \times 400}$$

$$(V_s)_{total} = \frac{4296}{200000} = 0.02148 \text{ m}^3$$

Step 2: Find Swept Volume per cylinder (V_s)

$$V_s = \frac{(V_s)_{total}}{n} = \frac{0.02148}{6} = 0.00358 \text{ m}^3$$

Step 3: Find Bore (D) and Stroke (L)

$$V_s = \frac{\pi}{4} D^2 L$$

Given $L = 1.25D$

$$V_s = \frac{\pi}{4} D^2 (1.25D) = 0.98175D^3$$

$$0.00358 = 0.98175D^3$$

$$D^3 = \frac{0.00358}{0.98175} = 0.003647$$

$$D = \sqrt[3]{0.003647} = 0.1539 \text{ m}$$

$$L = 1.25 \times D = 1.25 \times 0.1539 = 0.1924 \text{ m}$$

∴ Cylinder Dimensions: Bore, D = 153.9 mm; Stroke, L = 192.4 mm

Final Answer for Q-3:

Bore = 153.9 mm, Stroke = 192.4 mm

Q-4: A petrol engine with stroke length of 200 mm and diameter of 150 mm has a clearance volume of $7 \times 10^5 \text{ mm}^3$. If the indicated thermal efficiency is 0.30, find the relative efficiency. If the effective pressure is 5 bar and engine runs at 1000 r.p.m., find the ip of the engine. Take $\gamma = 1.4$

Answer:

Given:

- Stroke, $L = 200 \text{ mm} = 0.2 \text{ m}$
- Bore, $D = 150 \text{ mm} = 0.15 \text{ m}$
- Clearance Volume, $V_c = 7 \times 10^5 \text{ mm}^3 = 7 \times 10^{-4} \text{ m}^3$
- Indicated Thermal Efficiency, $\eta_{it} = 0.30$
- Mean Effective Pressure, $mep = 5 \text{ bar} = 500 \text{ kPa}$
- Speed, $N = 1000 \text{ rpm}$
- $\gamma = 1.4$

Part A: Find Relative Efficiency

Step 1: Find Compression Ratio (r)

$$\text{Swept Volume, } V_s = \frac{\pi}{4} D^2 L = \frac{\pi}{4} (0.15)^2 (0.2) = 0.003534 \text{ m}^3$$

$$\text{Clearance Volume, } V_c = 0.0007 \text{ m}^3$$

$$\text{Total Volume, } V_1 = V_s + V_c = 0.003534 + 0.0007 = 0.004234 \text{ m}^3$$

$$r = \frac{V_1}{V_c} = \frac{0.004234}{0.0007} = 6.049$$

Step 2: Find Air Standard Efficiency ($\eta_{air_standard}$)

For Otto cycle:

$$\eta_{air} = 1 - \frac{1}{r^{\gamma-1}} = 1 - \frac{1}{(6.049)^{0.4}}$$

$$(6.049)^{0.4} \approx 2.048$$

$$\eta_{air} = 1 - \frac{1}{2.048} = 1 - 0.4883 = 0.5117$$

Step 3: Find Relative Efficiency ($\eta_{relative}$)

$$\eta_{relative} = \frac{\eta_{it}}{\eta_{air}} = \frac{0.30}{0.5117} = 0.5863$$

∴ Relative Efficiency = 58.63%

Part B: Find Indicated Power (IP)

Assume it's a four-stroke engine.

$IP = \frac{mep \cdot V_s \cdot (N/2)}{60}$ for one cylinder.

$$IP = \frac{500 \times 0.003534 \times (1000/2)}{60}$$

$$IP = \frac{500 \times 0.003534 \times 500}{60}$$

$$IP = \frac{883.5}{60} = 14.725 \text{ kW}$$

∴ Indicated Power = 14.725 kW

Final Answers for Q-4:

1. Relative Efficiency = **58.63%**
2. Indicated Power = **14.73 kW**

Q-5: In a trial of a single cylinder oil engine , the following observations were made. Oil consumption = 10.2Kg/h Speed=1900 rpm Torque on the brake drum = 186N.m Question6. The following result refer to a test on I.C. engine Indicated the power = 42 KW Frictional power = 7 KW Engine speed = 1800 rpm Specific fuel consumption per b

Answer:

The problem statement is incomplete. It provides observations but no specific question.